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Jacques Silber
Paolo Verme

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Abstract

This paper proposes two new indices of relative deprivation, derived from an extension of the concept of the generalized Gini for the measurement of distributional change. Population- and income-weighted relative deprivation indices are then defined and, using panel data from the Consortium of Household Panels for European Socio-Economic Research, this paper checks which of the various ways of defining individual deprivation best fits the answers given by individuals on the degree of their satisfaction with income. The analysis finds that the deprivation indices proposed are consistently and negatively correlated with income satisfaction as reported by respondents, that income weighted measures fit better than population weighted measures, and that this fit improves with countries that experienced deep institutional changes such as the transitional economies of Eastern Europe.

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The author may be contacted at pverme@worldbank.org.

Relative Deprivation, Reference Groups and the Assessment of Standard of Living

Jacques Silber

Department of Economics, Bar-Ilan University, 52900 Ramat-Gan, Israel

Paolo Verme

The World Bank and

Department of Economics, "S. Cognetti de Martiis", University of Torino

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I) Introduction

Sociologists have for a long time made the assumption that individuals are concerned about their relative status. Such an emphasis may be found in the writings of Karl Marx who wrote that "our desires and pleasures spring from society, we measure them therefore by society and not by the objects which serve for their satisfaction. Because they are of a social nature they are of a relative nature"[1]. This idea of relative concern is also at the basis of the concept of relative deprivation which was introduced originally by Stouffer et al. (1949) and systematized by Runciman (1966) who also stressed the importance of reference groups. He argued that there does not seem to be a strong correlation between the level of "class-political discontent" and objective indicators of material deprivation so that this discontent is rather related to the gap which exists between one's economic and social conditions and the perceived conditions of some reference group.

Economists have also quite a long tradition of including relative income or status in models of utility maximization but for many years those taking such a point of view were the exception. Duesenberry (1949), for example, assumed that individuals have a desire for self-esteem and as a consequence they tend to imitate the consumption patterns of those who have a higher socioeconomic status. Similar ideas may be found in the works of Hirsch (1976) who coined the term "positional goods", Frank (1985) and in numerous papers analyzing in recent years the determinants of happiness (e.g., Blanchflower and Oswald, 2004, Clark, 2003, Ferrer-i-Carbonell, 2005). More recently Hopkins (2008) in a paper on happiness and relative concerns argued that there are at least three reasons why concern for relative position seems to be so deeply rooted in human behavior. His first explanation, which he calls the "rivalry story", stresses the fact that, in ancient times, men who were successful (e.g. in hunting) would use their

[1] This citation is taken from Pedersen (2004) but Pedersen himself seems to have found it in Rainwater (1974).

prestige and assets to dominate their companions, in particular in having priority in access to women. The second explanation seems to have been suggested by Samuelson (2004) and Rayo and Becker (2007) and was called the "information story" by Hopkins. Here the idea is that the conduct of individuals who are successful will be imitated. In other words "evolutionary selection has given you concerns about others in order to give you an incentive to gather useful information about potentially profitable activities" (Hopkins, 2008). Finally a third explanation, labeled the "perception story" by Hopkins, stresses the fact that in the same way as our evaluation of the taste of a given orange depends on the overall distribution of the taste of oranges, our satisfaction with a specific income depends on the overall distribution of incomes.

The importance of relative income is also stressed in another field of the economic literature, that dealing with inequality and relative deprivation. Borrowing the basic ideas of Runciman, but assuming that the reference group is the group of richer individuals, Yitzhaki (1979) showed the link that exists between the concept of relative deprivation and the Gini index. Additional contributions stressing similar ideas may be found in Hey and Lambert (1980), Yitzhaki (1982), Kakwani (1984) and Berrebi and Silber (1985). It must however be acknowledged that most of these works did not pay too much attention to the definition of the reference group. Studies that belong to the happiness literature gave somehow greater attention to this concept (see, Ferrer-i-Carbonell, 2005) but it was only very recently that specific proposals have been made to attempt to define the reference group of individuals (see, Bossert and D'Ambrosio, 2006; Kuegler, 2009; Verme and Izem, 2008, Verme, 2010, van Praag, 2010).

The purpose of the present paper is first to show how ideas that have appeared in the literature on income inequality measurement may be used to define reference groups and derive measures of relative deprivation. Then, using data on individual satisfaction, we try to find out which of these definitions of relative deprivation best fits the

subjective evaluation of one's own satisfaction. Such empirical tests are based on several European panel data that have been gathered in the database called Consortium of Household Panels for European Socio-Economic Research (CHER).

II) The Concept of Generalized Gini index and the Measurement of Relative Deprivation

Assume that y_i is the income of individual i, $\bar{y}$ the average income in the population, n the size of the population, and rank the individuals in such a way that $y_1 \geq \ldots \geq y_i \geq \ldots \geq y_n$. Berrebi and Silber (1985) then showed that the Gini index could be expressed as

$$I_G = \sum_{i=1}^{n} [((n-i)-(i-1))/n] s_i \qquad (1)$$

where $s_i = (y_i / n\bar{y})$ is the share of individual i in total income. Note that, following Donaldson and Weymark (1980), (1) may be rewritten as

$$\begin{aligned} I_G &= 1 - \sum_{i=1}^{n} [((2i-1)/n^2)(y_i/\bar{y})] = 1 - \{\sum_{i=1}^{n} [(i/n)^2 - ((i-1)/n)^2](y_i/\bar{y})\} \\ &= 1 - (y_{E,G}/\bar{y})\} \end{aligned} \qquad (2)$$

where

$$y_{E,G} = \sum_{i=1}^{n} [(i/n)^2 - ((i-1)/n)^2] y_i \qquad (3)$$

is the "equally distributed equivalent level of income"[2] corresponding to Gini's index.

[2] See, Atkinson, 1970, for more details on this concept.

Donaldson and Weymark (1980) have then extended (2) and defined a "generalized Gini" index I_{GG} as

$$I_{GG} = 1 - \{\sum_{i=1}^{n}[(i/n)^{\alpha} - ((i-1)/n)^{\alpha}](y_i/\bar{y})\} \tag{4}$$

with $\alpha \geq 2$.

The "equally distributed equivalent level of income" $y_{E,GG}$ corresponding to this "generalized Gini" index is then

$$y_{E,GG} = \sum_{i=1}^{n}[(i/n)^{\alpha} - ((i-1)/n)^{\alpha}]y_i \tag{5}$$

Clearly the higher α, the greater the weight given to poorer individuals.

If we define the population share of individual i as $f_i = (1/n)$ and note that $(y_i/\bar{y}) = (s_i/f_i)$, we may rewrite (4) as

$$I_{GG} = 1 - \{\sum_{i=1}^{n} a_i (s_i / f_i)\} \tag{6}$$

where the coefficient a_i is defined as

$$\begin{aligned} a_i &= [(i/n)^{\alpha} - ((i-1)/n)^{\alpha}] = \{[\sum_{j=1}^{i}(1/n)]^{\alpha} - [\sum_{j=1}^{i-1}(1/n)]^{\alpha}\} \\ &= \{[\sum_{j=1}^{i}(f_j)]^{\alpha} - [\sum_{j=1}^{i-1}(f_j)]^{\alpha}\} \end{aligned} \tag{7}$$

given that $f_j = (1/n) \forall j$.

Since $a_1 < a_2 < ... < a_i < ... < a_n$ and $\sum_{i=1}^{n} a_i = 1$, we may express (6) as

$$I_{GG} = \{\sum_{i=1}^{n} a_i[1-(s_i/f_i)]\} = \{\sum_{i=1}^{n} a_i[(f_i - s_i)/f_i]\} \qquad (8)$$

Note that in (8) the individuals i are classified by decreasing values of the ratios (s_i / f_i) in the same way as in Donaldson and Weymark's (1980) original paper individuals were ranked by decreasing incomes. Moreover, given the way a_i was defined, the smaller the ratio (s_i / f_i), the greater the weight a_i which is given to this ratio.

A more general interpretation may in fact be given to (8). We may consider the set $\{f_i\}$ of the individual population shares as "a priori probabilities" and the set $\{s_i\}$ of the individual incomes shares s_i as "a posteriori probabilities". Expression (8) may then be used to measure any "distributional change" that occurs when a set of "a priori probabilities" f_i is compared with a set of "a posteriori probabilities" s_i. Silber (1995) applied this idea to the specific case where the parameter α is equal to 2 (in which case I_{GG} in (4) is equal to the Gini index I_G defined in (2)) to measure distributional change. Deutsch and Silber (2005) extended this approach to derive "normative indices of occupational segregation" while Silber and Weber (2008) used this approach to derive population- and income-weighted Gini related mobility indices.

Expression (8) may therefore be also considered in a certain way as a measure of distributional change, where a comparison is made between the population shares f_i and the income shares s_i of the individuals. It is a population weighted-measure because the weights a_i depend only on the rank of the individuals in the income distribution.

Let us now apply this idea to the more general case where the set of shares f_i corresponds to the "predicted income share" of individual i (not necessarily his/her population share) and the set of shares s_i, as before, to the actual income share of this individual. More precisely assume that the income y_i of individual i is a function of a vector X_i of her personal characteristics (such as age, education,…) and suppose that we may express y_i as

$$y_i = \gamma + \delta X_i + \varepsilon_i \tag{9}$$

where ε_i includes the effect of unobserved factors on the income of individual i as well as the impact of measurement errors.

The "predicted" or "expected" income y_{Pi} of individual i will be defined as

$$y_{Pi} = \hat{\gamma} + \hat{\delta} X_i \tag{10}$$

where $\hat{\gamma}$ and $\hat{\delta}$ are estimates of γ and δ.

Equation (10) raises evidently the question of reference groups, that is, of the types of comparisons an individual makes when assessing his/her expected income. Persky and Tam (1990) believe that "an individual is more concerned about the difference between his income and that of his neighbors than the same difference between his income and that of persons far away from him". In other words these authors give a geographic interpretation to reference groups. McBride (2001) takes a broader view of reference groups and argues, on the basis of previous sociological and psychological research, that an individual first makes a comparison which is "sociological and outwardly oriented", looking therefore at the incomes of those who are in his/her cohort, the latter including, for example, people of similar age, gender, race or region. But an individual is also assumed to make an "adaptive, psychological comparison", based on his/her

personal consumption experience. Clark and Senik (2009) made a systematic analysis of the types of income comparisons that individuals make by looking at the data of Wave 3 of the European Social Survey. They concluded that self-employed are less likely to compare in general and that employees tend to compare to their colleagues. They also observed that "men compare less to family members than do women. Comparisons to colleagues increase after the age of 25, whereas the opposite is true of comparisons to family members and friends. The married compare more to family members and friends, and individuals with children compare more to family members…"

The approach taken in the present paper is somehow more akin to that of Ferrer-i-Carbonell (2005) who, in a study of income and well-being, assumed that the individual well-being depends on one's income, on the income of the reference group and on other variables such as age, education, the number of children living in the household, and whether the individual works. Ferrer-i-Carbonell (2005) defined the reference income of an individual as the average income of the reference group, the latter including all the individuals with a similar education level, inside the same age bracket, and living in the same region.

We similarly assumed that the relative deprivation of an individual, which is obviously negatively related to his/her well-being, depends on the comparison of the actual income of the individual with that of his/her reference group, the latter being the income he/she could have expected on the basis of his/her personal characteristics.

Applying expression (8) to such a comparison of predicted and actual income shares could amount in fact to defining a population weighted distributional change measure D_{PW} of relative deprivation with

$$D_{PW} = \sum_{i=1}^{n} \{ [\frac{((i^{\alpha}) - (i-1)^{\alpha})}{n^{\alpha}}][\frac{(s_i^E - s_i^A)}{s_i^E}] \} = \sum_{i=1}^{n} a_i [\frac{(s_i^E - s_i^A)}{s_i^E}] \qquad (11)$$

where a_i is defined as previously in (7) while s_i^A and s_i^E, which in (11) replace the shares s_i and f_i, refer respectively to the shares of individual i in the total actual and expected incomes of the society. Given that $E(\varepsilon_i)=0$, the average incomes $\bar{y}$ (average of the actual incomes y_i) and $\bar{y}_P$ (average of the predicted incomes y_{Pi}) are identical and hence so are the total values of the actual and expected incomes.

We may therefore rewrite (11) as

$$D_{PW}=\{\sum_{i=1}^{n} a_i[(s_i^E-s_i^A)/s_i^E]\}=\{\sum_{i=1}^{n} a_i[(y_{Pi}-y_i)/y_{Pi}]\} \qquad (12)$$

where the actual incomes y_i as well as the expected incomes y_{Pi} are ranked by decreasing values of y_i / y_{Pi} and where

$$a_i=\{[\sum_{j=1}^{i}(f_j)]^{\alpha}-[\sum_{j=1}^{i-1}(f_j)]^{\alpha}\} \qquad (13)$$

Expression (12) may also be written as

$$D_{PW}=\{\sum_{i=1}^{n} a_i[(\Delta y_i)/y_{Pi}]\} \qquad (14)$$

where $\Delta y_i=(y_{Pi}-y_i)$.

Borrowing again ideas from Silber (1995) and Silber and Weber (2008), we may also define an "income weighted deprivation index" D_{IW} with

$$D_{IW}=\{\sum_{i=1}^{n} b_i[(s_i^E-s_i^A)/s_i^E]\}=\{\sum_{i=1}^{n} b_i[(y_{Pi}-y_i)/y_{Pi}]\}=\sum_{i=1}^{n} b_i[(\Delta y_i)/y_{Pi}]\} \qquad (15)$$

where the weights b_i are defined as

$$b_i = \{[\sum_{j=1}^{i}(s_j^E)]^\alpha - [\sum_{j=1}^{i-1}(s_j^E)]^\alpha\} \quad (16)$$

and y_i and y_{Pi} are sorted in decreasing order of y_i / y_{Pi}.

Using (14) we may define a measure $d_{i,PW}$ of the individual deprivation of individual i as

$$d_{i,PW} = a_i(\Delta y_i / y_{Pi}) \quad (17)$$

Such a measure $d_{i,PW}$ should evidently be considered as a population-weighted measure of relative deprivation.

If one prefers to use an income weighted measure of relative deprivation, one may use (15) and define the measure $d_{i,IW}$ of the deprivation of individual i as

$$d_{i,IW} = b_i(\Delta y_i / y_{Pi}) \quad (18)$$

If in a given survey we have information on the income of an individual and on his/her individual characteristics as well as answers to a question where the individual is asked to say how satisfied he/she is with her income, we can regress the answers given by the individual to the latter question on the relative deprivation measures $d_{i,PW}$ and $d_{i,IW}$ that were defined previously and find out which of these two measures of individual deprivation, as well as which value of α give the best fit.

We can also compare the results obtained with those one would get when using other measures of individual deprivation. Yitzhaki (1979) proposed to measure the relative deprivation of individual i via the measure $d_{i,Y}$ defined as

$$d_{i,Y} = (1/n)\sum_{j \succ i}^{n}(y_j - y_i) \tag{19}$$

where it is assumed that $y_1 \leq \ldots \leq y_i \leq \ldots \leq y_n$.

More recently Silber and Verme (2010) defined the relative deprivation $d_{i,SV}$ of individual i as

$$d_{i,SV} = \{[\sum_{j \succ i}(1/n) - \sum_{j \succeq i}(1/n)](y_i / n\bar{y})\} - \{[\sum_{j \succ i}(1/n) - \sum_{j \succeq i}(1/n)](y_{Pi} / n\bar{y})\} \tag{20}$$

where both y_i and y_{Pi} are ranked by decreasing values of the actual incomes y_i.

III) An Empirical Illustration

The purpose of this section is to illustrate the use of the deprivation indices proposed and to test whether these indices capture effectively situations of deprivation as perceived by respondents in household surveys. The theoretical and statistical literature on relative deprivation is rich and diverse in terms of measures of deprivation. However, the empirical literature has paid very little attention to verifying whether existing indices capture effectively situations of deprivation as perceived by individuals. Here we can partly fill this gap by using a very comprehensive and little exploited set of European survey data.

The database we use is the Consortium of Household Panels for European Socio-economic Research (CHER).[3] This is a collection of panel survey data whose variables have been harmonized into a consistent data set. It includes 19 panel studies carried out

[3] The consortium was established in 2000 and is coordinated by CEPS/INSTEAD in Luxembourg who also holds the rights for the use of the data. For more information on the CHER project see Schmaus et al. (2003).

between 1990 and 2001 and totaling over 1.2 millions individual observations. To illustrate the indices proposed in this paper, we picked the longest panels available including the German Socio-Economic Panel (SOEP, 1991-2000), the British Household Panel Survey (BHPS, 1991-2000), the Polish Household Budget Survey (PHBS, 1994-2000) and the Hungarian Household Budget Survey (HHBS, 1992-1997).[4]

Data for Germany were further split into East and West Germany. This is because Germany reunited in 1989 and we expected Eastern and Western Germans to behave differently in relation to feelings of satisfaction and deprivation with income. The subdivision between East and West Germany follows the pre-1989 regional administrative division but it should be considered that many Eastern Germans migrated to West-Germany and, vice-versa, some Western Germans took residency in Eastern regions during the 1990s. Also, Eastern Germans are likely to have followed a process of adaptation to the new social and economic conditions and we should expect the behavior of Eastern regions to converge towards the behavior of Western regions.

The period considered (1991-2000) also coincides with the first decade of transition towards a market economy for East Germany, Poland and Hungary, a period characterized by recessions and deep institutional changes. In essence, our data provide the unique opportunity to observe and compare Western and Eastern European countries during a decade of extraordinary changes that we expected to be associated with significant swings in satisfaction and deprivation.

The variables of interest are income, predicted incomes and satisfaction with income. Income is measured in local currency, net of taxes and contributions and adjusted for inflation using the 2000-based deflators published by the IMF (World Economic Outlook report, October 2009). Predicted income is estimated with an OLS regression

[4] Note that the time period considered for Poland includes two separate panels, 1994-1996 and 1997-2000.

where the independent variables are sex (female), age (continuous), education (dummies for secondary and tertiary education), married (only formally married) and household size (number of household members). These are the variables we thought relevant for individuals when they compare their own income with the income of others. Evidently, this is a normative choice and these variables may change across countries. We opted for this particular set of variables because we expected this set to be rather standard across countries and because we wanted to use the same set of variables for the five countries considered so as to compare the performance of the indices across countries. Income satisfaction is measured on a scale from one to five as follows: 1) not at all satisfied; 2) somewhat dissatisfied; 3) neutral; 4) somewhat satisfied; 5) completely satisfied.[5] The sample considered is restricted to individuals with positive incomes who replied to the question on income satisfaction. In table 5, we also introduced additional labor market variables (employed and self-employed status) among the explanatory factors of the first-step equation. Location variables such as regional or urban-rural location would be normally important to add. People compare themselves with other people around them. However, the database we have does not have these location variables for all countries and years and we finally preferred to keep all countries/years available.

Our objective is to test whether the individual scores generated by the deprivation indices proposed are able to proxy well individual deprivation feelings as reported by respondents. As we use an income satisfaction variable, we expect to find a negative relation between individual income satisfaction and individual deprivation. In order to assess the correlation between these two variables, we use an ordered logit regression model where the dependent variable is income satisfaction and the independent variable

[5] Note that questions and answers for the different countries were slightly different in the original surveys. The five steps scale indicated in the text is the one reconstructed by the CHER consortium.

is the individual deprivation score of our measures. The empirical equation is simply described as[6]

$$S_i = \nu + \rho D_i + \varepsilon_i \tag{21}$$

where S_i is the degree of income satisfaction of individual i with $1 \leq S_i \leq 5$ while D_i can refer to one of the four individual measures of deprivation defined previously: $d_{i,PW}$ in expression (17), $d_{i,IW}$ in expression (18), $d_{i,Y}$ in expression (19) and $d_{i,SV}$ in expression (20). The parameters ν and ρ are to be estimated and ε_i is the error term. The ordered logit estimations are first carried out for each country and each year across individuals. We then reduce the sample to panel observations and replicate the equation with the pooled sample using country and year fixed effects and by country using year fixed effects. All estimations use the Huber-White robust estimator.[7]

Before we test the indices proposed, it may be instructive to look at the time trends of average income satisfaction of the five countries considered during the 1990s (Figure 1). The UK, which is the country that suffered the least the consequences from the transition from socialism to capitalism of Eastern European countries, shows a rather constant increase in income satisfaction, from a score of 3.3 in 1991 to 3.51 in 2000. West-Germany is the country that shows the highest scores in income satisfaction throughout the period. However, during the first few years of reunification, residents of West-Germany experienced a sharp drop in income satisfaction and only towards the end of the decade values returned closer to the pre-reunification levels. As compared to Western Europe, transition countries including East-Germany show lower average values in income satisfaction. However, it is rather clear that while residents of East

[6] Conditioning variables such as age and education should not be used in this equation as we are already controlling for these variables in the construction of the deprivation indicator.
[7] Note that regional clusters could not be used because the regional codes were not available for some countries and years.

Germany sharply improved income satisfaction during the 1990s, residents of Poland and Hungary did not. In fact, in both countries, average income satisfaction decreased although we can only observe a shorter period of time as compared to Germany and the UK.

[Figure 1]

Are changes in subjective income satisfaction reflected in changes in income deprivation as measured by the indices proposed? Results for the parametric estimates are presented in four tables where we show coefficients and significance levels of the individual deprivation scores regressed against income satisfaction for each country and year. In Table 1, we use the *population weighted* individual deprivation score $d_{i,PW}$ with values of the parameter α equal to 2 or 3. In Table 2, we use the *income weighted* individual deprivation score $d_{i,IW}$ with again values of the parameter α equal to 2 or 3. In Table 3, we report and compare results with two other deprivation indices, the measure $d_{i,Y}$ proposed by Yitzhaki (1979) and the measure $d_{i,SV}$ suggested by Silber and Verme (2010). Finally, in Table 4, which is based on the income weighted deprivation index, we restrict the sample to panel observations and use fixed effects to gather additional insights on cross-country differences and time trends.

The association between perceived income satisfaction and relative deprivation measured with the *population weighted index* is clearly negative as expected (Table 1). For all countries, with the exception of the UK, coefficients are negative and significant whether we use the inequality aversion parameter alpha equal to two or to three. The z-statistics are fairly large considering that the standard errors are estimated with Huber-White sandwich estimators. It is also evident that coefficients and significance levels seem to increase as we move from Western to Eastern European countries. Only a few

coefficients are significant for the UK and these coefficients are rather low whereas the same coefficients become consistently significant for West-Germany and increasingly so for East-Germany, Poland and Hungary. Considering that West-Germany has also been affected by the transition process due to the reunification process, we could derive that our population weighted index captures well changing feelings of income satisfaction due to deep institutional changes such as the one implied by the transition from socialism to capitalism. This may also explain the low values and significance levels of the coefficients in the UK, the country that has been affected the least by the transition process. In terms of the inequality aversion parameter alpha, we can also argue that a parameter equal to two is better calibrated for capturing changes in income satisfaction than a parameter equal to three.

[Table 1]

Even better results are obtained when using the *income weighted index* (Table 2). This index is able to capture well perceived income satisfaction also for the UK, especially with an aversion parameter equal to two. All coefficients in Table 2 are negative and significant and here too we observe that coefficients and significance levels increase as we move from Western to Eastern European countries. There are only three coefficients in the table that are not significant and these are all for the UK when we put alpha equal to three. As for the population weighted index, the income weighted index is better calibrated to capture changes in income satisfaction with an inequality aversion parameter of two rather than three.[8] Unlike the population weighted index, the income weighted index seems to better capture changes in income satisfaction when institutional changes are not so evident.

[8] Note that the indices proposed are based on incomes that are price adjusted. They are population invariant and consider exactly the same set of variables for predicting income, which implies that they are comparable across countries and years.

[Table 2]

As already mentioned, economics and other disciplines have offered a wide range of indices of relative deprivation, few of which have been used in empirical applications and none of which has been tested to see whether effectively captures sentiments of deprivation. In Table 3, we test the Yitzhaki (1979) relative deprivation index, which is perhaps the most popular relative deprivation index used in economics and the one that originated most of the contributions on the subject. We also test the Silber-Verme (2010) index, which builds on predicted incomes as the generalized indices proposed in this paper.

The Yitzhaki (1979) index performs rather well and better than the population weighted indices of Table 1 but worse than the income weighted indices of Table 2 (Table 3). In three of the ten years considered for the UK, the individual deprivation score is non-significant. The Silber-Verme (2010) index of relative deprivation is instead always negative and significant for all years and countries considered and its performance is comparable to the income weighted index when alpha is equal to two. This index, together with the income weighted index of Table 2 is the best performing index in terms of correlation with self-reported income satisfaction. As for the indices presented before, the coefficients of the Yitzhaki and Silber-Verme indices seem to increase as we move from Western to Eastern European countries.

[Table 3]

As a final test, we reduce the sample to balanced observations and use only the panel components of the surveys. This can be done for the UK, Germany (West and East) and

Hungary but not for Poland where we do not have a panel for the full period. We estimated first an ordered logit model on the pooled sample including all the countries but using country and year fixed effects. We then estimated ordered logit models for each country separately with year fixed effects. For this exercise we use only the income weighted index, the index that performed better in the previous applications. Results are presented in Table 4.

The coefficients of the deprivation score are all negative and significant at the 1% level. The pooled sample equation shows that there is a significant difference across countries but does not show any consistent trend across years although the coefficients for years are always negative and significant. Subjective income satisfaction and our relative deprivation measure are always negatively correlated but the strength of this correlation does not show a particular trend over time when countries are considered together.

Time trends become clearer when we discriminate across countries. In Hungary the coefficients of the year are significant only in two years while in the UK these coefficients are significant during the latest period 1997-2000 but not before. Instead in Germany, both East and West, the coefficients of the year are always significant and they tend to increase along the period. These results could be interpreted in terms of speed of institutional changes. In Hungary the process of transition has been rather slow as compared to East Germany while the UK did not experience institutional changes comparable to those occurred in Eastern Europe. Instead, both West and East Germany went through major institutional changes with the process of reunification that resulted in important swings in incomes, in the subjective satisfaction with income and also in the selection of the reference group. The German reunification is likely to have changed the reference group for individuals and one of the key novelties of our relative deprivation measures is precisely the inclusion in these measures of a self-selection mechanism of the reference group.

[Table 4]

Finally, we carry out a few tests to check on the implications of some of the empirical choices made and to check the sensitivity of results.[9] In Table 5, we replicated the model and equations used in Table 1, estimating in addition bootstrapped standard errors (columns 3 and 7), the R squared of the prediction equations of the first-step (columns 4 and 8) and adding to the model labor market variables (employed and self-employed with non-employed as base category – "Extended model"). Bootstrapped standard errors were estimated replicating 100-times the two-steps model to take into account the variance of both the first and second-step equation.

With a few exceptions, results show that bootstrap estimations of the standard error make little difference to inference in the base model while they make a larger difference in the extended model. The R squared of the first-step equation is also higher as one would expect in the extended model where we added the labor market variables. Inference is evidently affected by the specification of the first-step equation. As the explanatory power of the first-step equation increases, the variance of the predicted values also increases and this is likely to increase the variance of our relative deprivation measures which are constructed with predicted values. As a consequence, the estimation of the coefficients in the second-step equation may benefit from more variance but the true standard error may become more difficult to estimate. Therefore, the key choice of the model proposed is the one of the regressors in the first-step equation. The choice must include those variables that are widely recognized to be those used by people to select their peers (the reference group) and they must be limited to those variables. The objective is not to maximize the R squared of the first-step equation

[9] We are grateful to two referees for suggesting some of these tests.

but to estimate the true distance between actual and expected incomes that best measures the individual sense of deprivation.

IV) Concluding Comments

This paper proposed two new indices of relative deprivation, derived from an extension of the concept of generalized Gini, originally proposed by Donaldson and Weymark (1980), to the measurement of distributional change. The idea was to consider the predicted income share of an individual, obtained from a regression of his income on his personal characteristics, as an "a priori" share and his actual income as an "a posteriori" share. Using such an approach we defined population- as well as income-weighted relative deprivation indices. Using panel data from the Consortium of Household Panels for European Socio-Economic Research (CHER), we then checked which of these various ways of defining individual deprivation best fitted the answers given by individuals on the degree of their satisfaction with income.

We first concluded that the generalized formulation of the deprivation indices studied in this paper performs better when the parameter α is equal to 2 (the case of the traditional Gini index) than when it is equal to 3. A deprivation aversion parameter of „two" seems to be better calibrated for capturing self-reported feelings of satisfaction. Then we concluded that the income weighted indices perform better than the population weighted indices. This would suggest that both income and rank are important for people but that absolute incomes are relatively more important than rank. Third we observed that indices that make use of predicted incomes are better than those that use income alone. The Silber-Verme (2010) index seems thus better than the Yitzhaki (1979) index in capturing feelings of deprivation, as already stressed by Silber and

Verme (2010). Fourth we could not observe a time trend in the capacity of all indices to capture self-reported feelings of satisfaction within each country. Instead, we could see a difference for some of the indices in capturing differences between Germany and the UK. This may indicate that all indices studied adapt well to changes in individual behavior within countries while only some indices (the income weighted index with $\alpha = 2$ and the Silber-Verme, 2010 index) adapt to cultural or other differences across countries. Finally additional tests of the income weighted index with only panel observations have also shown that this index works well when major institutional changes are at work**.**

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Figure 1 – Average Income Satisfaction by Country (1991-2000)

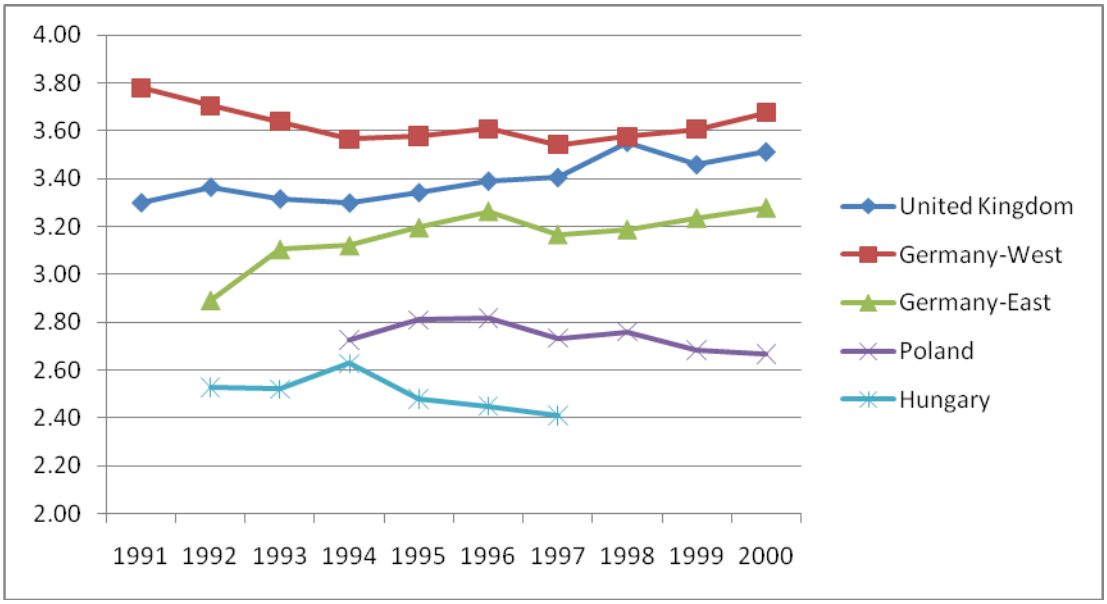

Table 1 – Subjective Income Satisfaction and Population Weighted Deprivation

		Alpha=2		Alpha=3		
		Coeff.	z-stat	Coeff.	z-stat	Obs.
United Kingdom	1991	-0.158	-0.82	0.027	-0.16	5128
	1992	0.059	-0.28	0.251	-1.42	4787
	1993	0.038	-0.21	0.273	-1.85	4590
	1994	-0.262	(2.25)*	-0.089	-0.8	4656
	1995	-0.348	-1.6	-0.06	-0.34	4568
	1996	-0.653	(2.80)**	-0.337	-1.75	4833
	1997	-0.409	-1.76	-0.135	-0.73	4826
	1998	-0.151	-0.84	-0.092	-0.75	4821
	1999	-0.919	(4.02)**	-0.55	(3.04)**	4710
	2000	-0.304	-1.15	-0.031	-0.14	4613
Germany-West	1991	-1.865	(4.97)**	-1.319	(4.28)**	7327
	1992	-1.692	(4.37)**	-1.192	(3.65)**	7359
	1993	-1.468	(3.91)**	-0.964	(2.99)**	7229
	1994	-2.314	(5.88)**	-1.67	(5.19)**	7083
	1995	-1.889	(4.19)**	-1.366	(3.65)**	7419
	1996	-1.414	(3.40)**	-0.955	(2.91)**	7348
	1997	-1.481	(3.90)**	-0.989	(3.20)**	7221
	1998	-1.686	(4.34)**	-1.114	(3.58)**	8109
	1999	-1.513	(3.47)**	-1.107	(3.08)**	7820
	2000	-1.77	(3.54)**	-1.221	(2.90)**	7590
Germany-East	1992	-1.886	(7.81)**	-1.455	(7.62)**	3570
	1993	-2.281	(8.36)**	-1.698	(8.07)**	3396
	1994	-2.675	(8.98)**	-1.969	(8.09)**	3339
	1995	-1.827	(6.60)**	-1.197	(5.58)**	3247
	1996	-1.892	(6.20)**	-1.319	(5.26)**	3218
	1997	-1.732	(5.38)**	-1.278	(4.81)**	3148
	1998	-2.15	(7.06)**	-1.481	(6.31)**	3318
	1999	-2.246	(7.72)**	-1.612	(7.23)**	3260
	2000	-2.165	(6.17)**	-1.542	(6.08)**	3239
Poland	1994	-4.929	(14.08)**	-3.495	(12.84)**	5775
	1995	-8.474	(19.39)**	-6.058	(18.01)**	8908
	1996	-7.95	(17.84)**	-5.823	(16.93)**	9084
	1997	-4.904	(14.62)**	-3.615	(14.11)**	5831
	1998	-3.973	(12.03)**	-2.896	(11.49)**	5679
	1999	-4.386	(13.84)**	-3.367	(13.82)**	5695
	2000	-4.065	(12.66)**	-3.061	(12.44)**	5689
Hungary	1992	-4.274	(13.98)**	-3.004	(12.52)**	4609
	1993	-3.098	(11.76)**	-2.212	(10.77)**	4093
	1994	-3.175	(13.21)**	-2.445	(12.61)**	3841
	1995	-3.247	(13.44)**	-2.395	(12.51)**	3393
	1996	-3.058	(13.55)**	-2.269	(12.91)**	2963
	1997	-2.292	(10.32)**	-1.749	(9.65)**	2348

Source: Elaborated from CHER database. Dep. Var. = Income satisfaction. Ordered Logit estimations. (*) significant at 5% level; (**) significant at 1% level.

Table 2 – Subjective Income Satisfaction and Income Weighted Deprivation

		Alpha=2		Alpha=3		
		Coeff.	z-stat	Coeff.	z-stat	Obs.
United Kingdom	1991	-1.172	(4.67)**	-0.673	(3.54)**	5128
	1992	-0.763	(2.82)**	-0.322	-1.56	4787
	1993	-0.708	(2.73)**	-0.259	-1.31	4590
	1994	-1.172	(4.57)**	-0.646	(3.28)**	4656
	1995	-1.104	(4.29)**	-0.585	(3.00)**	4568
	1996	-1.599	(5.84)**	-0.997	(4.78)**	4833
	1997	-0.984	(3.69)**	-0.557	(2.74)**	4826
	1998	-1.232	(4.40)**	-0.727	(3.42)**	4821
	1999	-1.461	(5.46)**	-0.945	(4.66)**	4710
	2000	-0.771	(2.74)**	-0.395	-1.85	4613
Germany-West	1991	-2.38	(5.55)**	-1.641	(4.95)**	7327
	1992	-2.185	(5.07)**	-1.389	(4.17)**	7359
	1993	-2.365	(5.76)**	-1.509	(4.76)**	7229
	1994	-3.219	(7.24)**	-2.235	(6.48)**	7083
	1995	-2.625	(5.04)**	-1.758	(4.34)**	7419
	1996	-2.455	(5.45)**	-1.552	(4.59)**	7348
	1997	-2.274	(5.43)**	-1.488	(4.74)**	7221
	1998	-2.713	(5.86)**	-1.745	(5.03)**	8109
	1999	-2.82	(5.38)**	-1.918	(4.76)**	7820
	2000	-3.286	(5.23)**	-2.27	(4.66)**	7590
Germany-East	1992	-2.167	(7.46)**	-1.466	(6.65)**	3570
	1993	-2.593	(9.05)**	-1.794	(8.32)**	3396
	1994	-2.857	(9.16)**	-2.019	(8.27)**	3339
	1995	-1.884	(6.57)**	-1.263	(5.92)**	3247
	1996	-1.616	(5.32)**	-1.125	(4.78)**	3218
	1997	-1.774	(5.68)**	-1.226	(5.00)**	3148
	1998	-2.097	(6.23)**	-1.478	(5.85)**	3318
	1999	-2.274	(7.13)**	-1.576	(6.65)**	3260
	2000	-2.451	(7.44)**	-1.696	(6.90)**	3239
Poland	1994	-4.466	(13.95)**	-2.997	(12.52)**	5775
	1995	-6.91	(17.06)**	-4.686	(15.57)**	8908
	1996	-6.339	(15.17)**	-4.247	(13.70)**	9084
	1997	-4.334	(14.49)**	-3.005	(13.64)**	5831
	1998	-3.346	(11.01)**	-2.232	(9.97)**	5679
	1999	-3.661	(11.82)**	-2.597	(11.28)**	5695
	2000	-3.341	(10.78)**	-2.264	(9.78)**	5689
Hungary	1992	-2.825	(10.22)**	-1.869	(9.12)**	4609
	1993	-1.892	(8.50)**	-1.235	(7.48)**	4093
	1994	-1.861	(8.73)**	-1.244	(7.93)**	3841
	1995	-1.994	(9.20)**	-1.303	(8.05)**	3393
	1996	-1.92	(9.04)**	-1.311	(8.25)**	2963
	1997	-1.037	(4.87)**	-0.651	(4.10)**	2348

Source: Elaborated from CHER database. Dep. Var. = Income satisfaction. Ordered Logit estimations. (*) significant at 5% level; (**) significant at 1% level.

Table 3 – Subjective Income Satisfaction and Yitzhaki (1979) and Silber-Verme (2010) Deprivation Indices

		Yitzhaki RD		Silber-Verme09		
		Coeff.	z-stat	Coeff.	z-stat	Obs.
United Kingdom	1991	-1.271	(2.51)*	-2.74	(4.81)**	5128
	1992	-0.861	-1.64	-1.886	(3.08)**	4787
	1993	-0.647	-1.29	-1.969	(3.33)**	4590
	1994	-1.44	(2.80)**	-3.12	(5.30)**	4656
	1995	-2.125	(4.13)**	-2.732	(4.66)**	4568
	1996	-2.358	(4.19)**	-3.93	(6.25)**	4833
	1997	-1.757	(3.23)**	-2.735	(4.46)**	4826
	1998	-1.768	(3.01)**	-3.092	(4.74)**	4821
	1999	-2.381	(4.20)**	-3.797	(6.10)**	4710
	2000	-1.007	-1.68	-2.266	(3.51)**	4613
Germany-West	1991	-7.216	(8.34)**	-5.923	(6.26)**	7327
	1992	-8.293	(8.96)**	-5.359	(5.60)**	7359
	1993	-7.384	(8.00)**	-5.571	(6.12)**	7229
	1994	-8.596	(9.31)**	-7.705	(7.77)**	7083
	1995	-8.256	(7.58)**	-6.344	(5.40)**	7419
	1996	-7.185	(7.24)**	-5.746	(5.57)**	7348
	1997	-6.729	(7.40)**	-5.452	(5.86)**	7221
	1998	-7.154	(7.49)**	-6.735	(6.55)**	8109
	1999	-7.453	(6.84)**	-6.479	(5.51)**	7820
	2000	-7.459	(6.20)**	-7.656	(5.36)**	7590
Germany-East	1992	-5.282	(9.24)**	-5.213	(8.15)**	3570
	1993	-6.132	(10.23)**	-6.363	(9.71)**	3396
	1994	-6.312	(7.67)**	-7.167	(10.01)**	3339
	1995	-4.102	(6.36)**	-4.975	(7.64)**	3247
	1996	-5.304	(7.76)**	-4.361	(6.33)**	3218
	1997	-5.481	(8.11)**	-4.392	(6.18)**	3148
	1998	-5.456	(8.10)**	-5.347	(7.22)**	3318
	1999	-5.359	(7.62)**	-5.473	(7.59)**	3260
	2000	-6.49	(10.10)**	-5.761	(7.17)**	3239
Poland	1994	-18.74	(20.17)**	-10.968	(13.53)**	5775
	1995	-30.692	(26.30)**	-17.627	(16.93)**	8908
	1996	-30.652	(26.25)**	-16.569	(15.73)**	9084
	1997	-17.9	(19.73)**	-10.942	(14.31)**	5831
	1998	-15.962	(18.24)**	-8.705	(11.24)**	5679
	1999	-17.032	(19.94)**	-9.628	(12.55)**	5695
	2000	-17.273	(20.27)**	-8.361	(10.79)**	5689
Hungary	1992	-13.993	(18.15)**	-7.82	(10.55)**	4609
	1993	-10.909	(16.28)**	-5.643	(9.00)**	4093
	1994	-12.269	(18.46)**	-5.224	(9.02)**	3841
	1995	-10.856	(17.45)**	-5.47	(9.36)**	3393
	1996	-10.402	(17.57)**	-5.379	(9.41)**	2963
	1997	-9.132	(14.93)**	-3.378	(5.63)**	2348

Source: Elaborated from CHER database. Dep. Var. = Income satisfaction. Ordered Logit estimations. Z-stat in parenthesis. (*) significant at 5% level; (**) significant at 1% level.

Table 4 – Fixed Effects Estimations, Panel Sample

	Pooled sample	Hungary	UK	Germany-West	Germany-East
Deprivation	-0.896***	-0.794***	-0.399***	-1.581***	-1.380***
	-0.0295	-0.0568	-0.0523	-0.0719	-0.0617
United Kingdom	1.458***				
	-0.0258				
Germany-West	1.773***				
	-0.0232				
Germany-East	0.922***				
	-0.0241				
year_1992	-0.233***		0.0889	-0.143***	
	-0.0367		-0.0737	-0.0482	
year_1993	-0.200***	0.0213	0.00811	-0.263***	0.375***
	-0.0367	-0.0691	-0.0728	-0.0484	-0.0608
year_1994	-0.194***	0.237***	-0.00915	-0.385***	0.451***
	-0.0367	-0.0691	-0.0729	-0.0483	-0.061
year_1995	-0.218***	-0.0716	0.0531	-0.363***	0.482***
	-0.0366	-0.0683	-0.073	-0.0482	-0.061
year_1996	-0.163***	-0.0948	0.0884	-0.286***	0.585***
	-0.0366	-0.0684	-0.0727	-0.0483	-0.061
year_1997	-0.257***	-0.224***	0.188**	-0.444***	0.436***
	-0.0366	-0.0683	-0.0729	-0.0482	-0.0606
year_1998	-0.139***		0.488***	-0.407***	0.438***
	-0.038		-0.0733	-0.0483	-0.0609
year_1999	-0.115***		0.388***	-0.401***	0.597***
	-0.038		-0.0735	-0.0483	-0.0611
year_2000	-0.0427		0.351***	-0.273***	0.659***
	-0.038		-0.0731	-0.0482	-0.0612
Observations	70719	8640	14130	31740	16209

Source: Elaborated from CHER database. Dep. Var. = Income satisfaction. Panel sample. Ordered Logit estimations. Standard errors under coefficients. (*) significant at 10% level; (**) significant at 5% level; (***) Significant at the 1% level.

Table 5 - TESTS

		Base Model (Table 1)				Extended Model				
		1	2	3	4	5	6	7	8	9
		Coeff.	s.e.	bootstr. s.e.	R2 (pred.eq.)	Coeff.	s.e.	bootstr. s.e.	R2 (pred.eq.)	Obs.
United Kingdom	1991	-0.158	0.193	0.206	0.27	-0.139	0.190	0.192	0.28	5128
	1992	0.059	-0.211	-0.214	0.26	0.055	-0.212	0.226	0.26	4787
	1993	0.038	-0.181	-0.177	0.26	0.025	-0.179	0.191	0.26	4590
	1994	-0.262	-0.116	-0.211	0.23	-0.262	-0.116	0.207	0.23	4656
	1995	-0.348	0.218	0.197	0.21	-0.356	0.218	0.253	0.21	4568
	1996	-0.653	-0.233	-0.255	0.22	-0.675	-0.234	0.260	0.22	4833
	1997	-0.409	0.232	0.223	0.2	-0.399	0.232	0.235	0.2	4826
	1998	-0.151	0.180	0.281	0.17	-0.145	0.175	0.284	0.17	4821
	1999	-0.919	-0.229	-0.343	0.14	-0.916	-0.228	0.359	0.14	4710
	2000	-0.304	0.264	0.229	0.19	-0.3	0.265	0.294	0.19	4613
Germany-West	1991	-1.865	-0.375	-0.409	0.28	-0.044	0.030	0.067	0.38	7327
	1992	-1.692	-0.387	-0.364	0.3	0.04	-0.046	0.032	0.42	7359
	1993	-1.468	-0.375	-0.399	0.3	-0.017	0.012	0.063	0.41	7229
	1994	-2.314	-0.394	-0.448	0.27	0.031	0.012	0.174	0.38	7083
	1995	-1.889	-0.451	-0.418	0.25	0.018	-0.022	0.051	0.35	7419
	1996	-1.414	-0.416	-0.417	0.28	-0.009	0.012	0.150	0.39	7348
	1997	-1.481	-0.380	-0.388	0.29	-0.016	0.010	0.072	0.42	7221
	1998	-1.686	-0.388	-0.361	0.26	-0.001	0.001	0.093	0.39	8109
	1999	-1.513	-0.436	-0.482	0.28	-0.017	0.009	0.044	0.41	7820
	2000	-1.77	-0.500	-0.519	0.29	0.076	0.028	0.116	0.41	7590
Germany-East	1992	-1.886	-0.241	-0.235	0.24	-1.239	-0.263	0.218	0.35	3570
	1993	-2.281	-0.273	-0.275	0.23	-1.497	-0.294	0.264	0.36	3396
	1994	-2.675	-0.298	-0.351	0.24	-1.48	-0.330	0.321	0.38	3339
	1995	-1.827	-0.277	-0.259	0.23	-0.231	0.321	0.293	0.34	3247
	1996	-1.892	-0.305	-0.315	0.26	-0.914	-0.353	0.350	0.36	3218
	1997	-1.732	-0.322	-0.314	0.24	-0.804	-0.364	0.418	0.35	3148
	1998	-2.15	-0.305	-0.280	0.19	-1.529	-0.330	0.354	0.31	3318
	1999	-2.246	-0.291	-0.281	0.2	-1.086	-0.353	0.425	0.33	3260
	2000	-2.165	-0.351	-0.355	0.19	-0.041	0.100	0.295	0.29	3239
Poland	1994	-4.929	-0.350	-0.378	0.05	-3.085	-0.370	0.745	0.16	5775
	1995	-8.474	-0.437	-0.531	0.04	-3.538	-0.454	1.401	0.13	8908
	1996	-7.95	-0.446	-0.464	0.11	-4.052	-0.476	0.660	0.26	9084
	1997	-4.904	-0.335	-0.478	0.06	-2.873	-0.391	0.983	0.17	5831
	1998	-3.973	-0.330	-0.389	0.1	-2.666	-0.346	0.532	0.22	5679
	1999	-4.386	-0.317	-0.335	0.09	-2.57	-0.381	1.044	0.2	5695
	2000	-4.065	-0.321	-0.422	0.08	-2.576	-0.316	0.741	0.19	5689
Hungary	1992	-4.274	-0.306	-0.327	0.21	-0.898	-0.273	0.464	0.3	4609
	1993	-3.098	-0.263	-0.263	0.24	-0.183	0.189	0.386	0.31	4093
	1994	-3.175	-0.240	-0.284	0.15	0.006	-0.004	0.065	0.21	3841
	1995	-3.247	-0.242	-0.283	0.22	-0.015	-0.006	0.139	0.31	3393
	1996	-3.058	-0.226	-0.246	0.15	-0.509	-0.237	0.429	0.24	2963
	1997	-2.292	-0.222	-0.284	0.09	-0.103	0.054	0.212	0.14	2348